CLAIMS:

What is claimed is:

1. A method of preparing a structure on a substrate comprising:

preparing a film stack comprising a thin film, a hard mask formed on said thin film, and a layer of light-sensitive material formed on said hardmask;

forming a pattern in said layer of light-sensitive material;

transferring said pattern to said hard mask;

removing said layer of light-sensitive material;

treating said surface layer of said hard mask in order to modify said surface layer; and

transferring said pattern to said thin film.

2. The method of claim 1, wherein said preparing comprises forming said hard mask comprising at least one of an organosilicon layer and an organo-metallic layer.

3. The method of claim 1, wherein said preparing comprises forming said hard mask comprising a tunable anti-reflective coating formed within said film stack having a structural formula R:C:H:X, wherein R is selected from the group consisting of Si, Ge, B, Sn, Fe, Ti, and combinations thereof, and wherein X is not present or is selected from the group consisting of one or more of O, N, S, and F.

4. The method of claim 1, wherein said removing said light-sensitive material comprises exposing said light-sensitive material to an oxygen-containing plasma.

5. The method of claim 1, wherein said treating said surface layer of said hard mask comprises exposing said hard mask layer to an oxygen-containing plasma.

6. The method claims 4, or 5, wherein said exposing said hard mask layer to said oxygen-containing plasma comprises exposing said hard mask layer to a plasma formed from the introduction of oxygen (O_2).

7. The method of claim 1, wherein said removing said light-sensitive layer and said treating said surface layer of said hard mask are performed concurrently.

8. The method of claim 1, further comprising:

determining an endpoint for completion of said removing said layer of light-sensitive material.

9. The method of claim 1, further comprising:

determining an endpoint for completion of said treating said surface layer of said hard mask.

10. A chemically altered hard mask comprising:

a hard mask layer; and

a chemically altered surface layer of said hard mask layer.

11. The chemically altered hard mask of claim 10, wherein said hard mask layer comprises an organosilicate layer.

12. The chemically altered hard mask of claim 10, wherein said hard mask layer comprises a tunable anti-reflective coating having a structural formula R:C:H:X, wherein R is selected from the group consisting of Si, Ge, B, Sn, Fe, Ti, and combinations thereof, and wherein X is not present or is selected from the group consisting of one or more of O, N, S, and F.

13. The chemically altered hard mask of claim 10, wherein said chemically altered surface layer comprises an oxidized hard mask surface layer.

14. A plasma processing system for treating a hard mask used for etching a feature in a thin film on a substrate comprising:

a process chamber;

a substrate holder coupled to said process chamber and configured to support said substrate;

means for introducing a treating gas;

means for forming a plasma; and

a controller coupled to said means for introducing said treating gas and said means for forming said plasma, and configured to execute a process recipe utilizing said plasma to chemically alter the surface layer of said hard mask.

15. The system of claim 14, wherein said treating gas comprises oxygen (O_2).

16. The system of claim 14, further comprising:

means for introducing an etching gas.

17. The system of claim 14, further comprising:

means for introducing an ashing gas.

18. The system of claim 14, further comprising:

a diagnostic system coupled to said process chamber and said controller, and configured to determine an endpoint of said utilizing said plasma to chemically alter the surface layer of said hard mask.

19. The system of claim 18, wherein said diagnostic system comprises an optical digital profilometry (ODP) system.

20. The system of claim 18, wherein said diagnostic system further comprises an optical emission spectroscopy (OES) system for detecting an endpoint of at least one of an etching process, and an ashing process.

21. The method of claim 4, wherein said exposing said light-sensitive material to said oxygen-containing plasma includes setting an exposure time and a substrate holder temperature for said exposure.

22. The method of claim 21, wherein said setting said exposure time includes setting said exposure time for approximately 10 seconds to approximately 200 seconds.

23. The method of claim 21, wherein said setting said substrate holder temperature includes setting said substrate holder temperature at approximately 20C to 400C.

24. The method of claim 5, wherein said exposing said hard mask layer to said oxygen-containing plasma includes setting an exposure time and a substrate holder temperature for said exposure.

25. The method of claim 24, wherein said setting said exposure time includes setting said exposure time for approximately 10 seconds to approximately 1200 seconds.

26. The method of claim 24, wherein said setting said substrate holder temperature includes setting said substrate holder temperature at approximately 20C to 400C.

27. The method of claim 1, wherein said removing said light-sensitive material is followed by said treating said surface layer of said hard mask, said exposing and said treating comprise exposing said substrate to an oxygen-containing plasma for an exposure time at a substrate holder temperature.

28. The method of claim 27, wherein said exposing said substrate to said oxygen-containing plasma for said exposure time at said substrate holder temperature includes exposing said substrate for said exposure time ranging from approximately 20 seconds to 1400 seconds, at said substrate holder temperature ranging from approximately 20C to 400C.